BIOLOGY LEADERS LOOK AHEAD

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On 22–24 March 2000, the American Institute of Biological Sciences, in conjunction with the Smithsonian Institution, hosted a conference entitled “Biological Challenges for the New Millennium.” The speakers, among the greatest living biologists, were asked to consider the notable achievements of their fields in the 20th century and how these achievements have set the stage for new directions and fresh discovery in the 21st century. For those who attended, these presentations offered a moment of profound reflection, when a century of biology was put in context, and one’s own small place and future could be seen on an immense canvas and in a brighter light. *A New Century of Biology*, edited by John Kress, tropical botanist at the Smithsonian Institution, and Gary Barrett, landscape ecologist and AIBS president in 1998, is a collection of essays, each authored by a different conference speaker, based on all but one of the presentations given at this meeting.

In the introduction, Barrett and Kress outline their overarching goal for the book: to address the processes that transcend all levels of biological organization and to emphasize integration among these levels. Each chapter author takes up a process to highlight (energetics, Gene Likens; development, Marvalee Wake; regulation, Lynn Margulis; behavior, Gordon Orians; diversity, Edward Wilson and Thomas Lovejoy; and conservation, Ghillean Prance and Daniel Janzen), giving a somewhat balanced approach among disciplines. I do not think this book truly synthesized the transdisciplinary accomplishments of biology, as envisaged in the introduction—there is little connection among chapters, with authors all developing their own themes independently. Nonetheless, each chapter illuminates a different view of past and future challenges in biology, and all are well worth reading.

The foreword, by Ernst Mayr, reminds us that biology is a young science, and that, although we have made remarkable advances in understanding processes—how a neuron fires or the nature of a gene, for example—the grand challenges still lie in knowing complex systems, such as the developmental system, the central nervous system, or the ecosystem.

Lynn Margulis, in the opening chapter, admonishes the community of biologists and stops us in our tracks from comfortably reflecting on a century of achievement. If we are to understand clues to the complexity of life, we can no longer generally ignore bacteria. In Margulis’s new century, bacteria will inform us about metabolic repertoires we have hardly considered, and we will learn that they hold amazing new collections of pathways. Genome sequences will reveal the degree to which life on earth has evolved as a result of microbial “genetic pack rats,” borrowing lots of genes from other organisms, such that our current
defining a species becomes outmoded.

What follows this grand opener is one of the most thoughtful and thought-provoking essays in the book, by Marvalee Wake, on the regulation of bodies and body plans and how they came to be. She achieves a truly transhierarchical approach, exploring four themes: the organizer; body plans and vertebrate ancestors; morphology and biomechanics; and development, morphology, and ecology. Her arguments and inspirations span the entire past century, making old ideas new and setting the stage for the major unanswered questions in morphology and development.

Gene Likens describes how the “black box” of ecosystem science has been gradually prised open over the 20th century with new techniques and experimental approaches that have made vital contributions toward understanding the impacts humans have on ecosystems. Major challenges now revolve around complex interactions in ecosystem analysis and the links between ecosystem ecology and other branches of biology. Likens’s personal commentary on the difficulties of managing interdisciplinary teams to address these complex interactions reminds us that many of the new challenges in biology are human.

Perhaps galvanized by the instructions to the authors to be “bold in their speculations,” Gordon Orians gently draws us in and entangles us in questions about animal behavior that seem some of the most difficult in biology: How do organisms do the right thing (from zygote to adult)? How does behavior influence the structure and functioning of ecological systems? Does behavior drive or constrain evolution? Can we determine the course of events leading to past and current behavior patterns? Answers to such questions will require powerful new ways of integrating ecology, animal behavior, and evolution.

Ghillean Prance restates the modern importance of the grand traditions of biological inventory, systematics collections, and botanical gardens, but offers new twists and cautions. For example, he suggests how these data may be used with molecular techniques and evolutionary analyses to ensure that conservation plans encompass the protection of genetic diversity as well as species-rich hotspots.

In an accompanying chapter, Tom Lovejoy reemphasizes how much more biological exploration is needed to learn about the diversity of life on Earth.

Dan Janzen’s essay explores a beautiful vision of wildlands that are conserved, understood, and used at the local level, because of their socioeconomic, cultural, and biological value. Janzen emboldens us with a daring, hopeful lucidity that this goal may be achieved. He transports us to the new ecological and management frontiers of dry tropical forest restoration in the Area de Conservación Guanacaste in Costa Rica to illustrate the principles of “lumpy integration” among biodiversity and ecosystem products and human society. Janzen’s uplifting vision is that in this new century of biology, our joy will come from learning to reassemble and manage lands, though he alerts us that “we do not have a century to meet these challenges.... We have just until tomorrow.”

The book concludes with a short but powerful essay by Edward O. Wilson, who summarizes some of the salient points from the program in his book Consilience to capture the unity of knowledge. This is an apt closing argument because of the conjoint consilience approach, tying what we know and plan for biological knowledge together with social and cultural knowledge into one great branch of learning.

Of course, the printed book cannot recapture the excitement of the March 2000 conference: the wild enthusiasm of Lynn Margulis’s film of unexplored life, the hushed awe that greeted the giant academic stature of Ernst Mayr and Edward O. Wilson, and the staccato rate of thought-provoking ideas emanating from Gordon Orians and Dan Janzen. But members of AIBS who read this book have an unusual luxury: They may visit the AIBS Web site and view videotapes of these presentations (see http://aibs.digestscript.com), thus combining the best of both worlds—the force of spoken delivery and reexamination of the written word.

In conclusion, each chapter is in itself a gem and the book a string of insightful views. Although these great minds are not dancing in unison, the whole is still greater than the sum of the parts because of the diversity of their approaches. The aim, to highlight transdisciplinary accomplishments in all fields of life sciences, is never fully realized, but that seems irrelevant. I recommend this book for any student, faculty member, schoolteacher, or researcher as a sampler from which to seek a momentary escape from their narrow discipline and immerse themselves in a broad sweep of biological ideas. A New Century of Biology is as rich and rewarding as the driving personalities and accomplishments of its authors, and it is an important archive of some key views in biology as we turned the corner into this century.

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